

(12) **United States Patent**
Hobson et al.

(10) **Patent No.:** **US 8,395,555 B2**
(45) **Date of Patent:** ***Mar. 12, 2013**

(54) **WIRELESS HANDHELD ELECTRONIC DEVICE**

(56) **References Cited**

(75) Inventors: **Phillip M. Hobson**, Menlo Park, CA (US); **Stephen P. Zadesky**, Portola Valley, CA (US); **Erik L. Wang**, Redwood City, CA (US); **Tang Yew Tan**, San Francisco, CA (US); **Richard Hung Minh Dinh**, San Jose, CA (US); **Adam D. Mittleman**, San Francisco, CA (US); **Kenneth A. Jenks**, Cupertino, CA (US); **Robert J. Hill**, Salinas, CA (US); **Robert W. Schlub**, Campbell, CA (US)

U.S. PATENT DOCUMENTS
4,644,366 A * 2/1987 Scholz 343/895
4,723,305 A * 2/1988 Phillips et al. 455/575.7
4,894,663 A 1/1990 Urbish et al.
4,980,694 A 12/1990 Hines
5,021,010 A 6/1991 Wright
5,041,838 A 8/1991 Liimatainen et al.
5,048,118 A 9/1991 Brooks et al.
5,561,437 A 10/1996 Phillips et al.
5,754,143 A 5/1998 Warnagiris et al.
5,798,984 A 8/1998 Koch
6,011,699 A 1/2000 Murray et al.
6,031,503 A * 2/2000 Preiss et al. 343/770
6,097,345 A 8/2000 Walton

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(Continued)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

OTHER PUBLICATIONS

U.S. Appl. No. 60/883,587, filed Jan. 5, 2007, Hobson et al.

(Continued)

Primary Examiner — Michael C Wimer

(74) *Attorney, Agent, or Firm* — Treyz Law Group; David C. Kellogg; G. Victor Treyz

(21) Appl. No.: **13/008,586**

(22) Filed: **Jan. 18, 2011**

(65) **Prior Publication Data**

US 2011/0109516 A1 May 12, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/142,552, filed on Jun. 19, 2008, now Pat. No. 7,876,274.

(60) Provisional application No. 60/936,796, filed on Jun. 21, 2007.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/846; 455/575.7**

(58) **Field of Classification Search** **343/700 MS; 343/702, 718, 846, 741, 767, 905, 906; 455/575.7**

See application file for complete search history.

(57) **ABSTRACT**

A handheld electronic device may be provided that contains a conductive housing and other conductive elements. The conductive elements may form an antenna ground plane. One or more antennas for the handheld electronic device may be formed from the ground plane and one or more associated antenna resonating elements. Transceiver circuitry may be connected to the resonating elements by transmission lines such as coaxial cables. Ferrules may be crimped to the coaxial cables. A bracket with extending members may be crimped over the ferrules to ground the coaxial cables to the housing and other conductive elements in the ground plane. The ground plane may contain an antenna slot. A dock connector and flex circuit may overlap the slot in a way that does not affect the resonant frequency of the slot. Electrical components may be isolated from the antenna using isolation elements such as inductors and resistors.

18 Claims, 38 Drawing Sheets

